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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte JIEBO LUO and QING YU

Appeal 2009-1110
Application 09/896,798
Technology Center 2600

Decided:[1] May 6, 2009

Before MAHSHID D. SAADAT, JOHN A. JEFFERY, and
ELENI MANTIS MERCADER, *Administrative Patent Judges*.

JEFFERY, *Administrative Patent Judge*.

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[1] The two-month time period for filing an appeal or commencing a civil action, as recited in 37 C.F.R. § 1.304, begins to run from the decided date shown on this page of the decision. The time period does not run from the Mail Date (paper delivery) or Notification Date (electronic delivery).

DECISION ON APPEAL

Appellants appeal under 35 U.S.C. § 134 from the Examiner's rejection of claims 16 and 18-26. We have jurisdiction under 35 U.S.C. § 6(b). We reverse.

STATEMENT OF THE CASE

Appellants invented a method for processing a digital image. The input digital image has N levels, and the output digital image has M levels, where M<N. The M levels are determined by organizing the pixel values of the input image into clusters based on the input image's gray level distribution. The clusters are revised until the cluster centers are below a predetermined threshold to minimize the mean squared error between the input image and output image. The method produces halftone patterns with reduced noise.[2] Independent claim 16 is reproduced below:

> 16. A method for multitone processing an N level digital image to produce an M level digital image wherein M and N have unchanging values and M<N, comprising the steps of:
>
> clustering all of the pixel values of the N level image into M reconstruction levels based on the gray level distribution of the N level image, wherein the clustering produces K clusters of pixel values, and wherein K=M;
>
> repeatedly revising said K clusters of pixel values until error between the N level digital image and the M level digital image is minimized, wherein throughout the repeated revising of said K clusters, the number of clusters K does not change;

[2] *See generally* Spec. 3:6-8 and 4:10-5:8.

> applying multilevel error diffusion to the N level digital image using said M reconstruction levels to produce the M level digital image; and
>
> applying said M level digital image to an image output device.

The Examiner relies upon the following as evidence in support of the rejection:

Merickel	US 4,945,478	July 31, 1990
Eschbach	US 5,565,994	Oct. 15, 1996
Klassen	US 5,621,546	Apr. 15, 1997
Revankar	US 5,649,025	July 15, 1997
Murayama	US 5,936,684	Aug. 10, 1999
Ishiguro	US 6,501,566 B1	Dec. 31, 2002 (filed Mar. 31, 1998)

1. Claims 16 and 21-23 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Murayama and Revankar (Ans. 3-6).

2. Claims 18 and 24 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Murayama, Revankar, and Ishiguro (Ans. 6-8).

3. Claim 19 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Murayama, Revankar, Merickel, and Eschbach (Ans. 8-9).

4. Claim 20 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Murayama, Revankar, Merickel, Eschbach, and Klassen (Ans. 9-11).

5. Claim 25 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Murayama, Revankar, and Eschbach (Ans. 11-12).

6. Claim 26 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Murayama, Revankar, Eschbach, and Klassen (Ans. 12-13).

Rather than repeat the arguments of Appellants or the Examiner, we refer to the Briefs and the Answer[3] for their respective details. In this decision, we have considered only those arguments actually made by Appellants. Arguments, which Appellants could have made but did not make in the Briefs, have not been considered and are deemed to be waived. *See* 37 C.F.R. § 41.37(c)(1)(vii).

Rejection Over Murayama and Revankar

Appellants argue claims 16 and 21-23 as a group (App. Br. 9-11). However, we will discuss claim 16 and claims 21-23 separately.

Claim 16

The Examiner finds that Murayama and Revankar collectively teach all the recited elements in independent claim 16 (Ans. 3-5). Specifically, the Examiner finds: (1) Murayama discloses the step of minimizing the error during its clustering process and that the number of clusters or K does not change (Ans. 3, 4, and 13) and (2) relies on Revankar only to teach repeatedly revising the clusters (Ans. 4 and 14). Appellants argue that the recursive or revising step in Revankar involves changing the number of clusters and, thus, does not teach the limitation of repeatedly revising the K clusters of pixel values such that "the number of clusters K does not change"

[3] Throughout this opinion, we refer to: (1) the Appeal Brief filed October 30, 2007; (2) the Examiner's Answer mailed December 12, 2007; and (3) the Reply Brief filed February 12, 2008.

in claim 16 (App. Br. 9-10; Reply Br. 4-5). Appellants also assert the Examiner is engaging in impermissible hindsight in formulating the rejection for claim 16 (App. Br. 10).

ISSUE

The following issue has been raised in the present appeal:

Under § 103, have the Appellants shown that the Examiner erred in finding that Murayama and Revankar collectively teach the step of repeatedly revising the K clusters of pixel values until the error between the N level digital image and the M level digital image is minimized and that the number of clusters K does not change throughout the repeated revising of the K clusters in rejecting claim 16?

FINDINGS OF FACT

The record supports the following findings of fact (FF) by a preponderance of the evidence.

Murayama

1. Murayama discloses an image processing method that converts the number of input image data gradations, such as color shades or grey scale, to a smaller number of output image gradations. Murayama provides an example where the input image has 256 gradations that are converted to four gradations. (Murayama, col. 1, ll. 6-12 and col. 2, ll. 16-23 and 46-53.)
2. Once the number of output image gradations is determined to be n graduations (e.g., 4), Murayama discloses n-1 threshold values (e.g., 3) are also calculated. Murayama discloses the threshold values are

calculated at s3 and s4, using the cumulative frequency distribution determined at s1 that shows the brightness in the range of 0 to 255 and the average (μ_2) and standard deviation (σ_2) of the brightness in the second class C2 at s2. (Murayama, col. 7, l. 24-col. 8, l. 61; Figs. 1, 2a, 2b, and 5.)

3. Murayama determines the average (μ_2) and standard deviation (σ_2) of the brightness of the second class or C2 at s2 using equation (5) to maximize the interclass variance at s23. (Murayama, col. 9, l. 53-col. 10, l. 65; Figs. 1 and 5.)
4. Murayama addresses how the second and third threshold values are calculated at s4. (Murayama, col. 8, ll. 23-61; Figs. 1 and 2b.)
5. At s5, each input image pixel in Murayama is assigned one of four brightness values (e.g., "0" to "3") using the threshold values for comparison. (Murayama, col. 8, l. 62-col. 9, l. 45; Figs. 1, 3, and 4.)

Revankar

6. Revankar teaches a process used to segment an image for a multi-level document image. (Revankar, title and col. 6, ll. 20-22.)
7. Revankar's process involves recursively thresholding (e.g., 204 and 206) each of two different histograms (e.g., 200 and 202) using a discriminant analysis-based technique and goodness values of thresholds (e.g., 208 and 210). The number of times the threshold is recalculated is found empirically and is constant (e.g., k=4). (Revankar, col. 5, ll. 10-15, and 60 and col. 6, ll. 20-44; Fig. 5.)
8. Revankar teaches the discriminant analysis-based method finds thresholds for each histogram (e.g., 200, 202 or 302, 306), determines

candidate thresholds having local maxima of goodness values k times through a recursive technique, and selects the final thresholds from the candidate thresholds (e.g., 214) based on the goodness values (e.g., 208, 210). Thresholds are added during the recursive process. (Revankar, col. 4, l. 51-col. 5, l. 49 and col. 6, l. 20-col. 7, l. 8; Figs. 5-6.)

PRINCIPLES OF LAW

Discussing the question of obviousness of a patent that claims a combination of known elements, *KSR Int'l v. Teleflex, Inc.*, 550 U.S. 398 (2007), explains:

> if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill. *Sakraida* [*v. AG Pro, Inc.,* 425 U.S. 273 (1976)] and *Anderson's-Black Rock*[*, Inc. v. Pavement Salvage Co.*, 396 U.S. 57 (1969)] are illustrative—a court must ask whether the improvement is more than the predictable use of prior art elements according to their established functions.

KSR, 550 U.S. at 417.

If the Examiner's burden is met, the burden then shifts to the Appellants to overcome the prima facie case with argument and/or evidence. Obviousness is then determined on the basis of the evidence as a whole and the relative persuasiveness of the arguments. *See In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992).

ANALYSIS

Murayama discloses a multitone processing method that converts the number of input image gray scale data gradations to a smaller number of output image gradations (FF 1). For example, Murayama discloses the input image has 256 gradations for an N level digital image that are converted to four gradations or M level digital image. (*Id.*) Each input image pixel is then assigned one of four brightness values (e.g., "0" to "3") or M reconstruction levels (FF 5). This assignment or clustering is achieved using threshold values for comparison that are based on the gray scale distribution on the N level image (FF 1-3). Thus, Murayama discloses the step of clustering all input image pixel values having an N level (e.g., 256 gradations) digital image into M reconstruction levels (e.g., four brightness values) based on the gray level distribution of the N level image. (*See* FF 1-5). Additionally, four brightness values are less than 256 gradations (FF 1), M<N, and the pixel values are organized into the brightness values (e.g., 4) that equal the same number as reconstruction levels (*see* FF 1 and 5), K=M.

However, we do not agree that Murayama discloses the step of minimizing the error during clustering, as the Examiner found (Ans. 3). Figure 2b and column 8, lines 44 through 49 of Murayama address how the second and third threshold values are calculated at s4 and do not discuss any error calculation. (*See* FF 4). Also, the step that determines the second and third thresholds at s4 occurs prior to Murayama's clustering routine at s5. (*See* FF 4-5). Moreover, Murayama discloses the calculations described in Figure 5, which includes calculating equation (5) at s23 to determine the average (μ_2) and standard deviation (σ_2) of the brightness of the second class C2, occur at s2. (*See* FF 3). Therefore, while column 10, lines 22 through

24 and equation (5) of Murayama discloses maximizing the interclass variance (FF 3) and may be considered an equation to minimize an error, these calculations also occur prior to any clustering routine. (*See* FF 3 and 5). Because these calculations occur prior to clustering, Murayama does not disclose minimizing the error between the N level digital image and the M level digital image during clustering or revising the clusters as claim 16 requires.

Since Murayama fails to disclose or teach minimizing an error during a clustering routine, we now address whether Revankar teaches the step of "repeatedly revising said K clusters of pixel values until error [sic] between the N level digital image and the M level digital image is minimized, wherein throughout the repeated revising of said K clusters, the number of clusters K does not change" recited in claim 16. Revankar teaches a process for generating a multi-level document image (FF 6). The process involves recursively thresholding (e.g., at 204 and 206) using a discriminant analysis-based method and goodness values of thresholds (FF 7). Specifically, Revankar teaches the discriminant analysis-based technique finds thresholds for each histogram (e.g., 200, 202 or 302, 306), determines candidate thresholds having local maxima of goodness values through a recursive technique, and selects the final thresholds from the candidate thresholds (e.g., 214) based on the goodness values (e.g., 208, 210) (FF 7-8).

During the recursive routine, the number of times the threshold is calculated or repeatedly revised is a constant value (e.g., k) which is found empirically, such as four times. (*Id.*) Because the revising is repeated a fixed number of times, Revankar's recursive process fails to teach the revising step is performed until an error is minimized as claim 16 requires.

Thus, even if Revankar's teaching of repeatedly revising the thresholds were included with Murayama's image processing method, the combined process would not include revising the clusters of pixel values "until error [sic] between the N level digital image and the M level digital image is minimized" as claim 16 recites.

Additionally, we agree with Appellants that thresholds are added during Revankar's recursive process (FF 8). Revankar specifically teaches that during the recursive threshold routine, candidate thresholds are added before the final candidate thresholds are selected. (*See* FF 8). Thus, the number of thresholds or clusters changes during the revising steps in Revankar, and Revankar also fails to teach "the number of clusters K does not change" as required by claim 16. Moreover, we previously discussed that Murayama does not disclose the claimed step of revising the clusters until an error between the N level digital image and the M level digital image is minimized. In fact, as the Examiner admits (Ans. 4), Murayama only clusters the pixel values once. Thus, the combination of Murayama and Revankar does not teach the limitation of "the number of clusters K does not change" during the repeatedly revising the threshold step recited in claim 16.

For the above reasons, the Examiner's rejection of claim 16 based on Murayama and Revankar is not sustained.

Claims 21-23

Independent claim 21 differs in scope from claim 16. Claim 21 does not recite repeatedly revising the K clusters of pixel values until an error between the N level digital image and the M level digital image is minimized, "wherein throughout the repeated revising of said K clusters, the

number of clusters K does not change." However, claim 21 does recite "M and N have unchanging values," "setting initial values of M cluster centers[,]" assigning pixels to the cluster centers, calculating new values of the cluster centers based upon the assigned pixels, and "repeating said assigning and calculating until a predetermined stopping condition is reached and, thereby, final values of said cluster centers are defined[.]"

ISSUE

The issue before us, then, is: have Appellants shown that the Examiner erred in finding Murayama and Revankar collectively teach the value of M is unchanged during the step of "repeating said assigning and calculating until a predetermined stopping condition is reached and, thereby, final values of said cluster centers are defined?"

ANALYSIS

Murayama discloses clustering or assigning the pixels once to a brightness value or level based on the thresholds. (*See* FF 5). For example a 256-level digital image is converted to one of four brightness levels (FF 1). As explained above, Murayama does not teach the repeating assigning and calculating steps. Revankar teaches a recursive thresholding routine that repeats k times or until a predetermined stopping condition (FF 7-8). However, as discussed above in connection with claim 16, Revankar's step of repeatedly calculating the thresholds also involves adding more thresholds and, in turn, adds more clusters. (*See* FF 8). Thus, the value of M or the digital image levels sent to the output device changes during the repeating step. As such, the combination of Murayama and Revankar do not teach the

limitation of "M and N have unchanging values" as required by claim 21. Also, because claims 22 and 23 depend from claim 21, Murayama and Revankar do not collectively teach these recitations.

For the above reasons, Appellants have shown the Examiner erred in rejecting claims 16 and 21-23 under 35 U.S.C. § 103 as being unpatentable over Murayama and Revankar.

Rejection Over Murayama, Revankar, and Ishiguro

The Examiner rejected claims 18 and 24 under 35 U.S.C. § 103(a) as being obvious over Murayama, Revankar, and Ishiguro (Ans. 6-8). Appellants argue that dependent claims 18 and 24 are patentable for the same reasons set forth with respect to their respective independent claims 16 and 21 (App. Br. 11). Based on above discussion in connection with claims 16 and 21, we are persuaded that Murayama and Revankar collectively do not teach the limitations of claims 18 and 24, and Ishiguro does not cure the deficiencies.

Rejection Over Murayama, Revankar, Merickel, and Eschbach

The Examiner rejected claim 19 under 35 U.S.C. § 103(a) as being obvious over Murayama, Revankar, Merickel and Eschbach (Ans. 8-9). Appellants argue that dependent claim 19 is patentable for the same reasons set forth with respect to independent claim 16 (App. Br. 11). Based on above discussion in connection with claim 16, we are persuaded that Murayama and Revankar collectively do not teach the limitations of claim 19, and Merickel and Eschbach do not cure the deficiencies.

For the above reasons, Appellants have shown the Examiner erred in rejecting claim 19 under 35 U.S.C. § 103.

Rejection Over Murayama, Revankar, Merickel, Eschbach, and Klassen

The Examiner rejected claim 20 under 35 U.S.C. § 103(a) as being obvious over Murayama, Revankar, Merickel, Eschbach, and Klassen (Ans. 9-11). Appellants argue that dependent claim 20 is patentable for the same reasons set forth with respect to independent claim 16 (App. Br. 11-12). Based on above discussion in connection with claim 16, we are persuaded that Murayama and Revankar collectively do not teach the limitations of claim 20, and Eschbach and Klassen do not cure the deficiencies.

For the above reasons, Appellants have shown the Examiner erred in rejecting claim 20 under 35 U.S.C. § 103.

Rejection Over Murayama, Revankar, and Eschbach

The Examiner rejected claim 25 under 35 U.S.C. § 103(a) as being obvious over Murayama, Revankar, and Eschbach (Ans. 11-12). Appellants argue that dependent claim 25 is patentable for the same reasons set forth with respect to independent claim 21 (App. Br. 12). We are persuaded by Appellants' argument with respect to claim 25 for the reasons disclosed above with regard to Murayama and Revankar and claim 21, and Eschbach does not cure the deficiencies.

For the above reasons, Appellants have shown the Examiner erred in rejecting claim 25 under 35 U.S.C. § 103.

Rejection Over Murayama, Revankar, Eschbach, and Klassen

The Examiner rejected claim 26 under 35 U.S.C. § 103(a) as being obvious over Murayama, Revankar, Eschbach, and Klassen (Ans. 12-13). Appellants argue that dependent claim 26 is patentable for the same reasons set forth with respect to independent claim 21 (App. Br. 12). We are persuaded by Appellants' argument with respect to claim 26 for the reasons disclosed above with regard to Murayama and Revankar and claim 21, and Eschbach and Klassen do not cure the deficiencies.

For the reasons discussed above, Appellants have shown the Examiner erred in rejecting claim 26 under 35 U.S.C. § 103.

CONCLUSIONS

(1) In rejecting claim 16 under § 103, Appellants have shown that the Examiner erred in finding that Murayama and Revankar collectively teach the step of "repeatedly revising said K clusters of pixel values until error [sic] between the N level digital image and the M level digital image is minimized, wherein throughout the repeated revising of said K clusters, the number of clusters K does not change."

(2) In rejecting claims 21-23 under § 103, Appellants have shown that the Examiner erred in finding Murayama and Revankar collectively teach the value of M is unchanged during the step of "repeating said assigning and calculating until a predetermined stopping condition is reached and, thereby, final values of said cluster centers are defined."

(3) For the reasons discussed above, we are also persuaded the Examiner erred in rejecting: (a) claims 18 and 24 under 35 U.S.C. § 103 as being unpatentable over Murayama, Revankar, and Ishiguro; (b) claim 19

under 35 U.S.C. § 103 as being unpatentable over Murayama, Revankar, Merickel and Eschbach; (c) claim 20 under 35 U.S.C. § 103 as being unpatentable over Murayama, Revankar, Merickel, Eschbach, and Klassen; (d) claim 25 under 35 U.S.C. § 103 as being unpatentable over Murayama, Revankar, and Eschbach; and (e) claim 26 under 35 U.S.C. § 103 as being unpatentable over Murayama, Revankar, Eschbach, and Klassen.

DECISION

The decision of the Examiner to reject claims 16 and 18-26 is reversed.

REVERSED

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